

REMARKS

The rejections of:

Claims 1, 3 and 4 under 35 U.S.C. § 102(b) as anticipated by U.S. 5,720,780 (Liu et al);

Claims 1-4 under 35 U.S.C. § 103(a) as unpatentable over U.S. 5,922,493 (Humphrey et al) in view of JP 2000-235868 (JP '868);

Claims 5 and 6 under 35 U.S.C. § 103(a) as unpatentable over Humphrey et al in view of JP '868 further in view of U.S. 4,668,595 (Yoshino et al);

Claims 1-4 under 35 U.S.C. § 103(a) as unpatentable over Liu et al in view of Humphrey et al and JP '868;

Claims 5 and 6 under 35 U.S.C. § 103(a) as unpatentable over Liu et al in view of Humphrey et al and JP '868 further in view of Yoshino et al;

Claims 7, 8, 14 and 15 under 35 U.S.C. § 103(a) as unpatentable over Yoshino et al in view of U.S. 6,106,973 (Sonozaki et al) and JP '868;

Claims 9-13 under 35 U.S.C. § 103(a) as unpatentable over Yoshino et al in view of Humphrey et al and JP '868; and

Claim 16 under 35 U.S.C. § 103(a) as unpatentable over Yoshino et al in view of Sonozaki et al and JP '868, and further in view of U.S. 5,244,757 (Takami et al) or U.S. 6,589,499 (Gao et al);

are all respectfully traversed.

The claimed invention is now the subject of two independent claims, i.e., Claims 3 and 7, and claims dependent thereon, respectively.

Claim 3 (and claims dependent thereon)

Claim 3 reads as follows:

A lithium secondary battery comprising an electrode composition and an electrolyte solution, wherein the electrode composition contains a poly(vinylidene fluoride) homopolymer being obtained by an emulsion polymerization process, as a binder, and the electrolyte solution contains a lithium fluoroborate-based salt as an electrolyte and  $\gamma$ -butyrolactone as a solvent.

Claim 3 requires **both** (1) an electrolyte solvent containing  $\gamma$ -butyrolactone **and** (2) a poly(vinylidene fluoride) homopolymer obtained by an emulsion polymerization process.

When both of these limitations are satisfied, a lithium secondary battery is obtained evincing unobviously superior properties and characteristics with regard to reducing a decrease in capacity of a lithium secondary battery. This is demonstrated by the comparative evidence in the specification, particularly Table 1 at page 23, reproduced below.

Table 1

Sample (%)	Rate of Capacity Decrease
Example 1	4.5
Example 2	6.7
Comp. Ex. 1	12
Comp. Ex. 2	14

As is evident from the results set forth in this table, when, as in Comparative Example 1,  $\gamma$ -butyrolactone is present, but the poly(vinylidene fluoride) homopolymer is a suspension polymerization derived homopolymer, or, as in Comparative Example 2, the poly(vinylidene fluoride) homopolymer is an emulsion derived polymerizate, but no  $\gamma$ -butyrolactone is present, significantly and materially inferior results are obtained. Such a result is manifestly unobvious.

The newly-submitted Maruyama Declaration provides further evidence of patentability. Example X-1, Comparative Example Z-1, Comparative Example Z-2 and Comparative Example Z-3 demonstrate the superiority of the present invention.

The combination of (EC+ $\gamma$ -butyrolactone) and PVDF(emulsion) was provided for Example X-1 as the solvent in electrolyte solution and the binder.

The combination of (EC+ $\gamma$ -butyrolactone) and PVDF(suspension) was provided for Comparative Example Z-1.

The combination of (EC+DEC) and PVDF(emulsion) was provided for Comparative Example Z-2.

The combination of (EC+DEC) and PVDF(suspension) was provided for Comparative Example Z-3.

“Capacity” and “rate of capacity decrease” of each battery are shown in Table 1.

“Rate of capacity” is obtained as (capacity of each battery / the reference capacity (230mAh)).

Table 1

	solvent in electrolyte solution	binder	capacity (mAh)	rate of capacity decrease (%)
Example X-1	EC+ $\gamma$ -butyrolactone	PVDF homopolymer obtained by <u>emulsion</u> polymerization	218	5.2
Comparative Ex. Z-1	EC+ $\gamma$ -butyrolactone	PVDF homopolymer obtained by <u>suspension</u> polymerization	202	13.7
Comparative Ex. Z-2	EC + DEC	PVDF homopolymer obtained by <u>emulsion</u> polymerization	205	10.9
Comparative Ex. Z-3	EC + DEC	PVDF homopolymer obtained by <u>suspension</u> polymerization	206	10.4

Example X-1, i.e., the combination of “ $\gamma$ -butyrolactone” and “PVDF homopolymer obtained by emulsion polymerization” produces a higher capacity (the rate of capacity decrease) than others.

Example X-1 and Comparative Example Z-1 show that manufacturing process of binder strongly affects the capacity (the rate of capacity decreases) of the batteries whose solvent has  $\gamma$ -butyrolactone. However, Comparative Example Z-2 and Z-3 show that manufacturing process of a binder does not affect the capacity (the rate of capacity decreases) of the batteries whose solvent does not have  $\gamma$ -butyrolactone.

It is shown clearly that the combination of “ $\gamma$ -butyrolactone” and “PVDF homopolymer obtained by emulsion polymerization” produces unexpected results.

Regarding the anticipation rejection, applicable precedent is stated in *In re Arkley*, 455 F.2d 586, 590, 172 USPQ 524, 526 (CCPA 1972) (**copy enclosed**):

[R]ejections under 35 U.S.C. 102 are proper only when the claimed subject matter is identically disclosed or described in "the prior art." Thus, for the instant rejection under 35 U.S.C. [102(b)] to have been proper, the . . . reference must clearly and unequivocally disclose the claimed [subject matter] or direct those skilled in the art to the [subject matter] without any need for picking, choosing, and combining various disclosures not directly related to each other by the teachings of the cited reference. Such picking and choosing may be entirely proper in the making of a 103, obviousness rejection, where the applicant must be afforded an opportunity to rebut with objective evidence any inference of obviousness which may arise from the similarity of the subject matter which he claims to the prior art, but it has no place in the making of a 102, anticipation rejection.

Liu et al does not meet the terms of *Arkley*.

With regard to the obviousness rejections, while Humphrey et al discloses PVDF homopolymer is preferably made by emulsion polymerization because it results in a relatively pure polymer, Humphrey et al neither discloses nor suggests that using such a PVDF homopolymer affects electrical properties, such as capacity, or the superior results obtained by the use of such PVDF homopolymer in combination with a  $\gamma$ -butyrolactone-containing solvent. Similarly, Liu et al does not disclose this combination, or the superior results obtained thereby. In addition, while the Examiner relies on JP '868 for its disclosure of  $\gamma$ -butyrolactone, JP '868 does not recognize the superior results obtained by the above-discussed combination. None of the other applied prior art remedies these deficiencies.

Claim 7 (and claims dependent thereon)

Claim 7 reads as follows:

A lithium secondary battery, wherein:  
a cathode, an anode and an electrolyte solution are encased in a housing, a lithium-containing composite oxide comprising lithium cobalt oxide is contained as a cathode active substance in the cathode, the lithium-containing composite oxide comprises lithium cobalt oxide and Nb, the amount of Nb is 0.001 to 2 at% relative to cobalt in the lithium cobalt oxide, the electrolyte solution contains  $\gamma$ -butyrolactone as a solvent, the concentration of  $\gamma$ -butyrolactone in the solvent is 60 to 95% by volume, and said housing has a thickness of 0.3 mm or smaller.

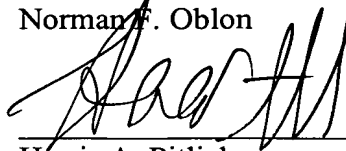
In addition to the above-discussed deficiencies of the applied prior art, none of the prior art discloses or suggests the use of Nb. This lack is sufficient to demonstrate patentability over this prior art. In addition, the applied prior art neither discloses nor suggests that the combination of Nb-containing additives and  $\gamma$ -butyrolactone suppress outgassing from electrolyte solutions and housing swelling.

For all the above reasons, it is respectfully requested that the rejections over prior art be withdrawn.

Applicants respectfully submit that all of the presently-pending claims in this application are now in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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